INCH-POUND

MIL-R-93E
5 October 2001
SUPERSEDING
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MILITARY SPECIFICATION

RESISTORS, FIXED, WIRE-WOUND (ACCURATE),
GENERAL SPECIFICATION FOR

INACTIVE FOR NEW DESIGN AFTER 22 NOVEMBER 1968.

This specification is approved for use by all Department and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for accurate, wire-wound, fixed resistors having a maximum resistance tolerance of 1 percent, with the winding suitably protected against high humidity. The resistors are suitable for continuous full load operation at any ambient temperature up to 125°C, and derated up to 145°C. They are not suitable for application where alternating current (ac) characteristics are of critical importance. Performance characteristics are in accordance with table I.

1.2 Classification.

1.2.1 Part or Identifying number (PIN). The PIN is in the following form:

RB52	C	E	12701	D
Style 1.2.1.1.1	Characteristic and terminal 1.2.1.2	Resistance temperature characteristic 1.2.1.3	Resistance 1.2.1.4	Resistance tolerance 1.2.15

1.2.1.1 Style. The style is identified by the two letter symbol RB followed by a two digit number; the letters identify accurate, wire wound, fixed resistors, and the number identifies the size and power rating of the resistor.

1.2.1.2 Characteristic and terminal. The characteristic and terminal are identified by a single letter in accordance with table II.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC-VAT, Post Office Box 3990, Columbus, Ohio 43216-5000 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 5905

TABLE I. Performance characteristics.

Characteristics	Style							
	RB52	RB53	RB54	RB55	RB56	RB57	RB70	RB71
Resistance tolerance (percent ±)	.05, .1, .5, 1	.05, .1, .5, 1	.05, .1, .5, 1	.05, .1, .5, 1	.05, .1, .5, 1	.05, .1, .5, 1	.05, .1, .5, 1	.05, .1, .5, 1
Minimum resistance (ohms)	100, 10, .1, .1	100, 10, .1, .1	100, 10, .1, .1	100, 10, .1, .1	100, 10, .1, .1	100, 10, .1, .1	100, 10, .1, .1	100, 10, .1, .1
Maximum resistance (megohms)	1.5	.750	.511	.226	.127	2.0	.301	.100
Resistance temperature Characteristic								
Under 1 ohm	±90	±90	±90	±90	±90	±90	±90	±90
1 to 10 ohms	±50	±50	±50	±50	±50	±50	±50	±50
10 ohms to max	±20	±20	±20	±20	±20	±20	±20	±20
Power rating (watt) at 125°C	.5	.33	.25	.15	.125	.75	.25	.125
Maximum operating voltage (volts)	600	300	300	---	---	600	150	---
Maximum percent change in Resistance 1/								
Life (full load at 125°C)	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5	±0.5
Short time overload	±0.1	±0.1	±0.1	±0.1	±0.1	±0.1	±0.1	±0.1
Thermal shock	±0.2	±0.2	±0.2	±0.2	±0.2	±0.2	±0.2	±0.2
Moisture resistance	±0.25	±0.25	±0.25	±0.25	±0.25	±0.25	±1.00	±1.00
Dielectric withstanding voltage	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05
Terminal strength	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05	±0.05
Low temperature operation	±0.25	±0.25	±0.25	±0.25	±0.25	±0.25	±0.25	±0.25
Low temperature storage	±0.20	±0.20	±0.20	±0.20	±0.20	±0.20	±0.20	±0.20
High temperature exposure	±0.50	±0.50	±0.50	±0.50	±0.50	±0.50	±0.50	±0.50
Shock, specified pulse	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10
Vibration, high frequency	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10	±0.10
Insulation resistance (megohms)								
Before moisture resistance	1,000	1,000	1,000	1,000	1,000	1,000	1,000	1,000
After moisture resistance	100	100	100	100	100	100	100	100

NOTE: All “C” terminals are solderable in accordance with method 208 of MIL-STD-202.

1/ Where total resistance change is 1 percent or less, it is considered as ±(_percent + 0.05 ohm).

TABLE II. Temperature characteristic and terminal.

Symbol	Terminal	Maximum ambient temperature at rated wattage	Maximum ambient temperature (at zero percent rated wattage dissipation)
C	Solderable	125°C	145°C
W	Weldable	125°C	145°C

1.2.1.3 Resistance temperature characteristic. The resistance temperature characteristic is identified by a single letter in accordance with table III.

TABLE III. Resistance temperature characteristic.

Symbol	<1 ohm	1 ohm < 10 ohms	10 ohms and above
E	±90 ppm	±50 ppm	±20 ppm

1.2.1.4 Resistance. The nominal resistance expressed in absolute ohms (1 absolute ohm = 0.99951 international ohm) is identified by five digits; the first four digits represent significant figures and the last digit specifies the number of zeros to follow. When the values of resistance is less than 1,000 ohms, or when fractional values of an ohm are required, the letter R is substituted for one of the significant digits to represent the decimal point. When the letter R is used, succeeding digits of the group represent significant figures. The resistance value designations are shown in table IV. Minimum and maximum resistance values are specified (see 3.1). The standard values for every decade follows the sequence demonstrated for "10 to 100" decade in table V. The resistance values for 0.05 percent and 0.1 percent resistance tolerances may be of any value within the limits of this specification, but it is preferred that the values be chosen from the "10 to 100" decade specified in table V.

TABLE IV. Designation of resistance values.

Designation	Resistance value
R1000 to R9880 inclusive	0.10 to 0.988 inclusive
1R000 to 9R880 inclusive	1.00 to 9.88 inclusive
10R00 to 98R80 inclusive	10.00 to 98.80 inclusive
100R0 to 988R0 inclusive	100.00 to 988.00 inclusive
10000 to 98800 inclusive	1,000 to 9,880 inclusive
10001 to 98801 inclusive	10,000 to 98,800 inclusive
10002 to 98802 inclusive	100,000 to 988,000 inclusive
10003 to 98803 inclusive	1,000,000 to 9,880,000 inclusive

TABLE V. Standard resistance values for the 10 to 100 decade.

Resistance tolerance											
A, B, D	F	A, B, D	F	A, B, D	F	A, B, D	F	A, B, D	F	A, B, D	F
10.00	10.00	14.70	14.70	21.50	21.50	31.60	31.60	46.40	46.40	68.10	68.10
10.10		14.90		21.80		32.00		47.00		69.00	
10.20	10.20	15.00	15.00	22.10	22.10	32.40	32.40	47.50	47.50	69.80	69.80
10.40		15.20		22.30		32.80		48.10		70.60	
10.50	10.50	15.40	15.40	22.60	22.60	33.20	33.20	48.70	48.70	71.50	71.50
10.60		15.60		22.90		33.60		49.30		72.30	
10.70	10.70	15.80	15.80	23.20	23.20	34.00	34.00	49.90	49.90	73.20	73.20
10.90		16.00		23.40		34.40		50.50		74.10	
11.00	11.00	16.20	16.20	23.70	23.70	34.80	34.80	51.10	51.10	75.00	75.00
11.10		16.40		24.00		35.20		51.70		75.90	
11.30	11.30	16.50	16.50	24.30	24.30	35.70	35.70	52.30	52.30	76.80	76.80
11.40		16.70		24.60		36.10		53.00		77.70	
11.50	11.50	16.90	16.90	24.90	24.90	36.50	36.50	53.60	53.60	78.70	78.70
11.70		17.20		25.20		37.00		54.20		79.60	
11.80	11.80	17.40	17.40	25.50	25.50	37.40	37.40	54.90	54.90	80.60	80.60
12.00		17.60		25.80		37.90		55.60		81.60	
12.10	12.10	17.80	17.80	26.10	26.10	38.30	38.30	56.20	56.20	82.50	82.50
12.30		18.00		26.40		38.80		56.90		83.50	
12.40	12.40	18.20	18.20	26.70	26.70	39.20	39.20	57.60	57.60	84.50	84.50
12.60		18.40		27.10		39.70		58.30		85.60	
12.70	12.70	18.70	18.70	27.40	27.40	40.20	40.20	59.00	59.00	86.60	86.60
12.90		18.90		27.70		40.70		59.70		87.60	
13.00	13.00	19.10	19.10	28.00	28.00	41.20	41.20	60.40	60.40	88.70	88.70
13.20		19.30		28.40		41.70		61.20		89.80	
13.30	13.30	19.60	19.60	28.70	28.70	42.20	42.20	61.90	61.90	90.90	90.90
13.50		19.80		29.10		42.70		62.60		92.00	
13.70	13.70	20.00	20.00	29.40	29.40	43.20	43.20	63.40	63.40	93.10	93.10
13.80		20.30		29.80		43.70		64.20		64.20	
14.00	14.00	20.50	20.50	30.10	30.10	44.20	44.20	64.90	64.90	95.30	95.30
14.20		20.80		30.50		44.80		65.70		96.50	
14.30	14.30	21.00	21.00	30.90	30.90	45.30	45.30	66.50	66.50	97.60	97.60
14.50		21.30		31.20		45.90		67.30		98.80	

1.2.1.5 Initial resistance tolerance. The initial resistance tolerance is identified by a single letter in accordance with table VI.

TABLE VI. Initial resistance tolerance.

Symbol	Initial resistance tolerance
	Percent (±)
A	0.05
B	0.10
D	0.50
F	1.00

2. APPLICABLE DOCUMENT

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specification and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

DEPARTMENT OF DEFENSE

MIL-PRF-39005 - Resistors, Fixed, Wire-Wound (Accurate), Nonestablished Reliability, Established Reliability, General Specification for.

(See supplement 1 for a list of associated specifications.)

STANDARDS

DEPARTMENT OF DEFENSE

MIL-STD-202	- Test Methods Standard for Electronics and Electrical Component Parts.
MIL-STD-810	- Environmental Test Methods and Engineering Guidelines.
MIL-STD-1276	- Leads for Electronic Component Parts.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Service, Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents that are DoD adopted are those listed in the issue of the DoDISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI)

ANSI/NCSL Z540-1	- Calibration Laboratory and Measuring and Test Equipment, General Requirements for.

INTERNATIONAL ORGANIZATION for STANDARDS (ISO)

ISO 10012-1	- Quality Assurance Requirements for Measuring Equipment, Part 1: Meteorological Confirmation System for Measuring Equipment.

(Applications for copies should be addressed to the American National Standards Institute, 11 West 42nd Street, New York, NY 10036.)

2.4 Order of precedence. In event of a conflict between the text of this document and the references cited herein (except for related associated specifications, specification sheets, or MS sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern (see 6.2).

3.2 Qualification. Resistors furnished under this specification shall be products that are qualified for listing on the applicable qualified product list (QPL) before contract award (see 4.4 and 6.3).

3.3 Materials. Materials shall be used which will enable the resistors to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guaranty of the acceptance of the finished product.

3.4 Interface and physical dimension. Resistors shall meet the interface and physical dimensions as specified (see 3.1). The resistor assembly shall be protected by a coating or enclosure of moisture resistant insulating material which will withstand exposure to the humidity and temperature conditions specified herein. Unless otherwise specified (see 3.1), in order to minimize inductance, resistors shall be wound by Reverse pi-winding, Bifilar, Ayrton-Perry, or equivalent method.

3.4.1 Terminals. Terminals shall be made of a solid conductor of the length and diameter specified (see 3.1). The terminals shall be solderable in accordance with method 208 of MIL-STD-202.

3.4.1.1 Wire lead terminals. Wire lead terminals shall be made of a solid conductor of the length and diameter specified (see 3.1). The termination of element to terminal shall not depend on solder or welding alone to attain mechanical strength.

3.4.1.2 Solderable terminals. Solderable terminals shall be suitably treated to meet the requirements of solderability (see 3.9).

3.4.1.3 Weldable terminals. Weldable terminals shall be as specified in table II. The manufacturer shall verify by certification that the weldable leads meet all the applicable requirements of MIL-STD-1276 (see 3.1). The solderability requirement of 3.9 is not applicable to weldable terminals.

3.4.2 Tin plated finishes. Use of tin plating is prohibited as a final finish and as an undercoat (see 6.9). Use of tin-lead (Sn-Pb) finishes are acceptable provided that the minimum lead content is 3 percent.

3.4.3 Protective coating or enclosure. Resistor assemblies shall be protected by a coating or enclosure of moisture resistant insulating material, that shall completely cover the exterior of the resistance element, including connections or terminations. The coating shall not crack, craze, drip, run, or form globules at any temperature up to and including 145°C, regardless of the mounting position of the resistor. This material shall afford protection against the effects of prolonged exposure to high humidities. The protective coating or enclosure shall be such as to minimize the establishment of leakage paths between the terminals resulting from collection of moisture film on the external surface of the resistor.

3.4.4 Solder dip (retinning) leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip process (see appendix) has been approved by the qualifying activity.

3.4.5 Power rating. Resistors shall have a power rating based on continuous full load operation at an ambient temperature of 125°C (see 3.1). This power rating is dependent on the ability of resistors to meet the life requirements of 3.15. For temperatures in excess of 125°C, the load shall be derated in accordance with figure 1 (see 6.6).

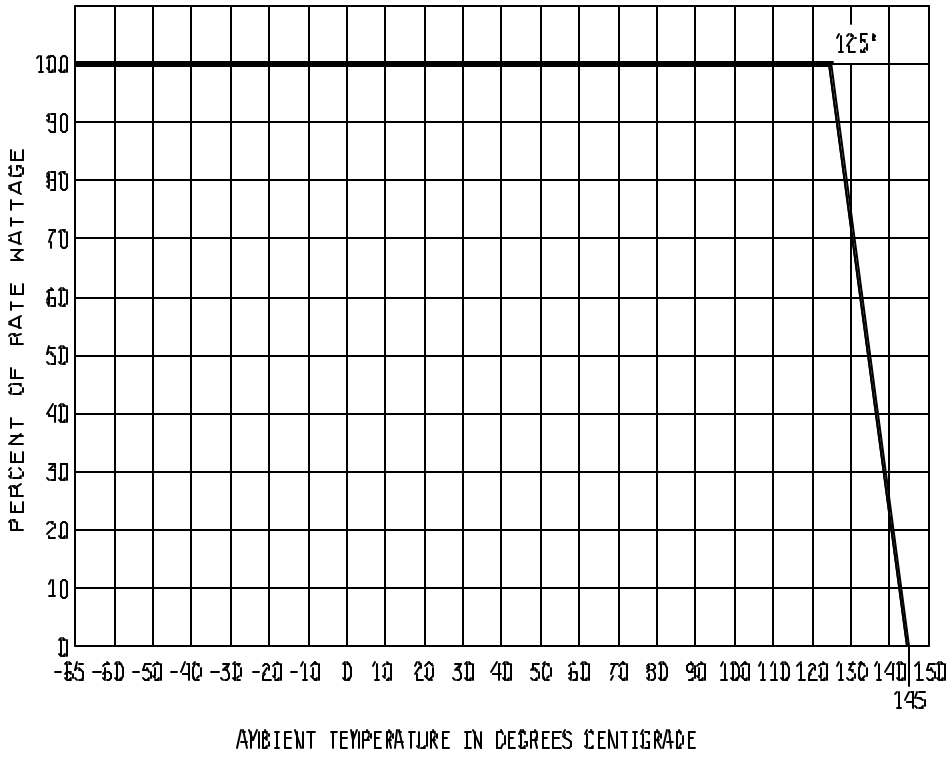

FIGURE 1. Derating curve for high ambient temperatures.

3.5 Voltage rating. Resistors shall have a rated direct current (dc) continuous working voltage, or an approximate sine wave root mean square (rms) continuous working voltage at commercial line frequency and waveform corresponding to the power rating, as determined from the following formula:

$$E = \sqrt{PR}$$

Where: E = rated dc or rms continuous working voltage.
P = power rating (see 3.1).
R = nominal resistance.

3.6 DC resistance. When resistors are tested as specified in 4.7.2, the dc resistance shall be expressed in absolute ohms (see 1.2.1.4) and shall be within the specified initial resistance tolerance of the nominal resistance (see 1.2.1.5).

3.7 Short time overload. When resistors are tested as specified in 4.7.3, there shall be no evidence of arcing, burning, or charring. The change in resistance shall not exceed the initial resistance tolerance specified in the type designation (see 1.2.1.5) or ±(0.1 percent +0.05 ohm), whichever is smaller.

3.8 Thermal shock. When resistors are tested as specified in 4.7.4, there shall be no mechanical damage. The change in resistance shall not exceed ±(0.2 percent +0.05 ohm)

3.9 Solderability (not applicable to terminal type W). When resistors are tested as specified in 4.7.5, they shall meet the applicable criteria for terminal evaluation in the referenced test method.

3.10 Resistance to solvents. When resistors are tested as specified in 4.7.6, there shall be no evidence of mechanical damage and the marking shall remain legible.

3.11 Insulation resistance. When resistors are tested as specified in 4.7.7, the insulation resistance shall be not less than 1,000 megohms.

3.12 Moisture resistance. When resistors are tested as specified in 4.7.8, there shall be no evidence of breaking, cracking, spalling, or loosening of terminals or mounting hardware. The final insulation resistance shall be not less than 100 megohms. The change in resistance between the initial and final resistance measurements shall not exceed ±(1.0 percent +0.05 ohm) for styles RB70 and RB71, and ±(0.25 percent +0.05 ohm) for all other styles.

3.13 Dielectric withstanding voltage. When resistors are tested as specified in 4.7.9, there shall be no evidence of flashover, mechanical damage, arcing, or insulation breakdown. The change in resistance shall not exceed ±(0.05 percent +0.05 ohm).

3.14 Terminal strength. When resistors are tested as specified in 4.7.10, there shall be no breaks in the wire lead terminals; the resistance element shall remain securely connected mechanically and electrically to the terminals in such a manner that the normal movement of the terminals shall not result in strain, wear, or damage to the element, coating, or enclosure. The change in resistance shall not exceed ±(0.05 percent +0.05 ohm).

3.15 Life. When resistors are tested as specified in 4.7.11, there shall be no evidence of mechanical damage to the resistance element, coating, or enclosure. The change in resistance between the initial resistance measurement and any succeeding measurement shall not exceed ±(0.5 percent +0.05 ohm).

3.16 Resistance temperature characteristic. When resistors are tested as specified in 4.7.12, the resistance temperature characteristic referred to an ambient temperature of 25°C shall not exceed the value specified in table III.

3.17 Low temperature storage. When resistors are tested as specified in 4.7.13, there shall be no evidence of mechanical damage. The change in resistance between the initial and final resistance measurements at 25°C ±5°C shall not exceed ±(0.2 percent +0.05 ohm).

3.18 Low temperature operation. When resistors are tested as specified in 4.7.14, there shall be no evidence of mechanical damage. The change in resistance between the initial and final resistance measurements at 25°C ±5°C shall not exceed ±(0.25 percent +0.05 ohm).

3.19 High temperature exposure. When resistors are tested as specified in 4.7.15, there shall be no damage or loosening under a mounting bolt, where applicable. The change in resistance shall not exceed ±(0.5 percent +0.05 ohm).

3.20 Shock, specified pulse. When resistors are tested as specified in 4.7.16, there shall be no evidence of mechanical or electrical damage. The change in resistance shall not exceed ±(0.1 percent +0.05 ohm). There shall be no electrical discontinuity during the test.

3.21 Vibration, high frequency. When resistors are tested as specified in 4.7.17, there shall be no evidence of mechanical or electrical damage. The change in resistance shall not exceed ±(0.1 percent +0.05 ohm). There shall be no electrical discontinuity during the test.

3.22 Fungus. All external materials shall be non-nutrient to fungus growth or shall be suitably treated to retard fungus growth. The supplier shall verify by certification that all external materials are fungus resistant or shall test the resistors as specified in 4.7.18. There shall be no evidence of fungus growth.

3.23 Marking. Resistors shall be marked with the PIN (see 1.2.1), and the manufacturer's name, trademark, or code symbol. If space permits, the resistance value in absolute ohms, the initial resistance tolerance, the rated or maximum voltage or the power rating, as applicable, shall also be marked. There shall be no space between the symbols which comprise the type designation. If lack of space requires it, the PIN shall be divided between the resistance temperature characteristic letter and the first digit of the resistance value, as shown in the following example:

RB08CE
12701D

Marking shall remain legible at the end of all tests.

3.23.1 Designation marking of resistance values for .05 percent resistance tolerances. The designation of resistance values for resistance tolerances of .05 percent, when used with nondecade resistance values shall be as follows:

a. The nominal ohmic value shall be marked below the last line of the PIN as shown.

RB08CE-----D
1123550

b. If two are used, the nominal ohmic value shall be marked below the last line of the PIN as shown.

RB08CE
-----D
1123550

NOTE: Standard marking procedure as shown (see 3.23) where applicable.

3.24 Soldering. Electrical connections shall be mechanically secure before and electrically continuous after soldering.

3.25 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.26 Workmanship. Resistors shall be processed in such a manner as to be uniform in quality and free from any defects that will affect life, serviceability, or appearance.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Qualification inspection (see 4.4).

b. Conformance inspection (see 4.6).

4.2 Test equipment and inspection facilities. The manufacturer shall establish and maintain a calibration system in accordance with ANSI/NCSL Z540-1, ISO 10012-1, or equivalent system as approved by the qualifying activity.

4.3 Inspection conditions and precautions.

4.3.1 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in the “GENERAL REQUIREMENTS” of MIL-STD-202.

4.3.2 Precautions. Adequate precautions shall be taken during inspection to prevent condensation of moisture on resistors except during the moisture resistance temperature cycling test. Precautions shall also be taken to prevent damage by heat when soldering resistor leads to terminals.

4.4 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3).

4.4.1 Sample. The number of sample units comprising a sample of resistors to be submitted for qualification inspection shall be as specified in the appendix to this specification.

4.4.2 Test routine. Sample units shall be subjected to the qualification inspection specified in table VII, in the order shown. All coated or enclosed sample units with exception of group IA samples shall be subjected to the inspection of group I. The remaining 24 coated or enclosed sample units shall then be divided as specified in table XIV, for groups II to V, inclusive and subjected to the inspection for their particular group. The 2 uncoated or unenclosed sample units shall be subjected to the visual and mechanical examination of group VII only.

4.4.3 Failures. Failures in excess of those allowed in table VII shall be cause for refusal to grant qualification.

TABLE VII. Qualification inspection.

Inspection	Requirement paragraph	Method paragraph	Number of sample units for inspection	Number of defectives allowed 1/
Certification requirements				
Fungus	3.22	4.7.18		N/A
Group I				
DC resistance	3.6	4.7.2		
Visual and mechanical examination 2/	3.1, 3.3 to 3.4.3 inclusive, 3.23 to 3.26 inclusive	4.7.1	100 percent	0
Short time overload	3.7	4.7.3		
Thermal shock	3.8	4.7.4		
Group IA				
Solderability 3/	3.9	4.7.5	10	
Resistance to solvents	3.10	4.7.6		
Group II				
Insulation resistance	3.11	4.7.7		
Moisture resistance	3.12	4.7.8	6	
Dielectric withstanding voltage	3.13	4.7.9		
Terminal strength	3.14	4.7.10		
Group III				
Life	3.15	4.7.11	6	
Group IV				
Resistance temperature characteristic	3.16	4.7.12		
Low temperature storage	3.17	4.7.13	6	
Low temperature operation	3.18	4.7.14		
High temperature exposure	3.19	4.7.15		
Group V				
Shock, specific pulse	3.20	4.7.16	6	
Vibration, high frequency	3.21	4.7.17		
Group VI				
Visual and mechanical examination	3.1, 3.3 to 3.4.3 inclusive, 3.23 to 3.26 inclusive	4.7.1	2	

1/ Failure of a resistor in one or more tests of a group shall be charged as a single defective.
2/ Marking shall be considered defective only if the marking is illegible.
3/ Not applicable to terminal type W.

4.5 Retention of qualification. Every 12 months, the manufacturer shall verify the retention of qualification to the qualifying activity. In addition, the manufacturer shall immediately notify the qualifying activity whenever the group B inspection results indicate failure of the qualified product to meet the requirements of this specification. Verification shall be based on meeting the following requirements:

a. The manufacturer has not modified the design of the item.

b. The specification requirements for the item have not been amended so far as to affect the character of the item.

c. Lot rejection for group A inspection does not exceed the group A sampling.

d. The requirements for group B inspection are met.

When group B requirements were not met and the manufacturer has taken corrective action satisfactory to the Government, group B retesting shall be instituted.

4.6 Conformance inspection.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of group A and group B inspection.

4.6.1.1 Inspection lot. An inspection lot, as far as practicable, shall consist of all resistors of the same style produced in a period not to exceed 30 days, produced under essentially the same conditions, and offered for inspection at one time.

4.6.2 Group A inspection. Group A inspection shall consist of the examination and test specified in table VIII, and shall be made on the same set of sample units, in the order shown.

TABLE VIII. Group A inspection.

Inspection	Requirement paragraph	Method paragraph	Number of samples
Subgroup 1			
DC resistance	3.6	4.7.2	
Visual and mechanical examination	3.1	4.7.1	
Body and mounting dimensions	3.1, 3.4		See 4.6.2.1.1
Marking	3.23		
Workmanship	3.26		
Subgroup 2			
Solderability	3.9	4.7.5	See 4.6.2.2.1

4.6.2.1 Subgroup 1.

4.6.2.1.1 Sampling plan. A sample of parts from each inspection lot shall be randomly selected in accordance with table IX. If one or more defects are found, the lot shall be screened and defectives removed. After screening and removal of defectives, a new sample of parts shall be randomly selected in accordance with table IX. If one or more defects are found in this second sample, the lot shall be rejected and shall not be supplied to this specification. Resistance values in the samples shall be representative, and where possible, in proportion to the resistors in the inspection lot.

4.6.2.2 Subgroup 2.

4.6.2.2.1 Sampling plan. Thirteen samples shall be selected randomly from each inspection lot and subjected to the subgroup 2 solderability test. The manufacturer may use electrical rejects from subgroup 1 screening tests for all or part of the samples to be used solderability testing. If there is one or more defects, the lot shall be considered to have failed.

TABLE IX. Group A sampling plan.

Lot size	Number of samples
2 to 13	100 percent
14 to 150	13
151 to 280	20
281 to 500	29
501 to 1,200	34
1,201 to 3,200	42
3,201 to 10,000	50
10,001 to 35,000	60
35,001 to 150,000	74
150,001 to 500,000	90
500,000 and over	102

4.6.2.2.2 Rejected lots. In the event of one or more defects, the inspection lot is rejected. The manufacturer may use one of the following options to rework the lot.

a. Each production lot that was used to form the failed inspection lot shall be individually submitted to the solderability test as required in 4.7.5. Production lots that pass the solderability test can be reworked only if submitted to the solder dip procedure in 4.6.2.2.2.b.

b. The manufacturer submits the failed lot to a 100 percent solder dip using an approved solder dip process in accordance with the appendix. Following the solder dip the electrical measurements required in group A, subgroup 1 tests shall be repeated on 100 percent of the lot. The percent defective allowable (PDA) for the electrical measurements shall be as for the subgroup 1 tests. Thirteen additional samples shall then be selected and subjected to the solderability test with zero defects allowed. If the lot fails this solderability test, the lot shall be considered rejected and shall not be furnished against the requirements of this specification.

4.6.2.2.3 Disposition of samples. The solderability test is considered a destructive test and samples submitted to the solderability test shall not be supplied on the contract.

4.6.3 Group B inspection. Group B inspection shall consist of the tests specified in table X, in the order shown. The inspection shall be performed on sample units which have been subjected to and passed group A inspection.

TABLE X. Group B inspection.

Test	Requirement paragraph	Method paragraph	Number of samples
Short time overload	3.6	4.7.3	See 4.6.3.1
Thermal shock	3.7	4.7.4	

4.6.3.1 Sampling plan. Thirteen sample units per lot shall be subjected to group B inspection with no failures permitted.

4.6.3.2 Small quantity production. If no more than 75 resistors of the same style or group of styles defined for lot formation (see 4.6.1.1) are produced during a continuous 3 month period, the entire 3 month production may be submitted as one lot. In case of failure, the entire lot shall be rejected and all units involved shall be subjected to corrective action.

4.6.3.3 Disposition of sample units. Sample units that have been subjected to group B inspection shall not be delivered on the contract or purchase order.

4.6.4 Inspection of preparation for delivery. Sample package or packs and the inspection of the preservation, packing and marking for shipment and storage shall be in accordance with the requirements in section 5.

4.6.5 Alternate inspection. For the purpose of retention of qualification and conformance inspection (see 4.5 and 4.6), test results on identical items covered by MIL-PRF-39005 may be used.

4.7 Methods of inspection.

4.7.1 Visual and mechanical examination. Resistors shall be examined to verify that the materials, design, construction, physical dimensions, marking and workmanship are in accordance with applicable requirements (see 3.1, 3.3 to 3.4.3, inclusive, and 3.23 to 3.26, inclusive).

4.7.2 DC resistance (see 3.6). Resistors shall be tested in accordance with method 303 of MIL-STD-202. The following details and exceptions shall apply:

a. Measuring apparatus: Different types of measuring test equipment (multimeters, bridges, or equivalent) are permitted to be used on the initial and final readings of this test, provided the equipment is the same style, model, or if it can be shown that the performance of the equipment is equivalent or better.

b. Limit of error of measuring apparatus: The maximum error of the measuring instrument shall not exceed the lesser of:

(1) One fourth of the initial resistance tolerance +0.002 ohm.

(2) One tenth percent of the measured resistance +0.002 ohm.

c. Measurement energy for electronic test equipment: The measurement energy applied to the unit under test shall not exceed 10 percent of the 25°C rated wattage times 1 second.

d. Test voltage for bridges: Measurements or resistance shall be made by using the test voltages specified in table XI. The test voltage chosen, whether it be the maximum or a lower voltage which would still provide the sensitivity required, shall be applied across the terminals of the resistor. This same voltage shall be used whenever a subsequent resistance measurement is made.

TABLE XI. DC resistance test voltages.

Resistance, nominal (ohms)			0.5 watt and greater (volts)	Less than 0.5 watt (volts)
Less than 1 ohm			0.1	0.05
1 to	9.999	inclusive	0.3	0.15
10 to	99.99	inclusive	1.0	1.00
100 to	999.9	inclusive	3.0	3.00
1,000 to	9,999	inclusive	10.0	3.00
10,000 to	99,999	inclusive	30.0	10.00
100,000 and higher		inclusive	100.0	30.00

e. Points of application of test voltage for initial resistance tolerance measurement (see 3.1):

(1) Wire lead terminal resistors of 10 ohms and less: .375 inch ±.0625 inch (9.53 mm ±1.588 mm) from the end of the body.

f. Temperature: The dc resistance test specified in group I of table VII shall be measured at 25°C ±2°C. For all other tests, unless otherwise specified herein, the temperature at which subsequent and final resistance measurements are made in each test shall be within 2°C of the temperature at which the first resistance measurement was made.

4.7.3 Short time overload (see 3.7). DC resistance shall be measured as specified in 4.7.2. Each resistor shall be subjected to a dc test potential equivalent to that calculated for twice the rated wattage, but not to exceed twice the maximum voltage (see 3.1), for 10 minutes under the following conditions:

a. In free space, predicated on horizontal mounting with the resistor mounted in a minimum of 0.5 inch (12.7 mm) from any other resistor or the mounting base.

b. In still air, with no circulation other than that created by the heat of the resistors being operated.

Thirty minutes +15 minutes, -0 minutes after removal of the test potential, the dc resistance shall again be measured as specified in 4.7.2. Resistors shall then be examined for evidence of arcing, burning, and charring.

4.7.4 Thermal shock (see 3.8). Resistors shall be tested in accordance with method 107 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting: In such a manner as to present a minimum obstruction to the airstream. In no case shall the fixture prevent the specified ambient temperature from being achieved within 4 minutes after the resistors are placed in the chamber.

b. Measurement before cycling: DC resistance shall be measured as specified in 4.7.2.

c. Test condition: B.

d. Measurement after cycling: Not less than 1 hour, but within a 24 hour period after the last cycle, dc resistance shall be measured as specified in 4.7.2.

e. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.5 Solderability (see 3.9). Resistors shall be tested in accordance with method 208 of MIL-STD-202. The following detail shall apply: Both terminals shall be tested. The terminals shall be dipped within 0.0625 inch of the body.

4.7.6 Resistance to solvent. (see 3.10). Resistors shall be tested in accordance with method 215 of MIL-STD-202. The following details shall apply:

a. The marked portion of the resistor body shall be brushed.

b. The number of sample units shall be as specified in table VII.

c. Resistors shall be examined for mechanical damage and legibility of markings.

4.7.7 Insulation resistance (see 3.11). Resistors shall be tested in accordance with method 302 of MIL-STD-202 with the following exceptions:

a. Special preparation for wire lead resistors: Resistors shall be clamped in the trough of a 90° metallic V-block of such size that the body of the resistor does not extend beyond the extremities of the block. The resistor leads shall be so positioned that one of the points of contact of the periphery of the resistor with the V-block is the point at which the distance from the surface of the resistor leads to the periphery of the resistor body is a minimum. The minimum distance to the periphery of the resistor body shall be measured from the point of emergence of the resistor lead.

b. Test condition: A or B, whichever is greater.

c. Points of measurement: Between the resistor terminals connected together and the mounting strap.

4.7.8 Moisture resistance (see 3.12). Resistors shall be tested in accordance with method 106 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting for wire lead terminal resistors: Resistors shall be soldered by their leads to rigid mounts or terminal lugs. The spacing of the mounts shall be such that the length of each resistor lead is approximately .375 inch (9.53 mm) when measured from the edge of the supporting terminal to the resistor body. One half of the specimens shall be covered with a V-shaped strap whose width is such that the resistor shall not extend more than 0.5 inch (12.7 mm) beyond the edge of the strap. The strap shall be made of a corrosion resistant metal and shall be kept in contact with the resistor body by supporting the resistor body as indicated on figure 2, with a nonconducting, noncorrosive support whose width is less than that of the body and which will not act as a moisture trap. The mounting straps may be individual for each resistor or continuous for all resistors.

b. Initial measurements: Immediately following the initial drying period, the dc resistance shall be measured as specified in 4.7.2.

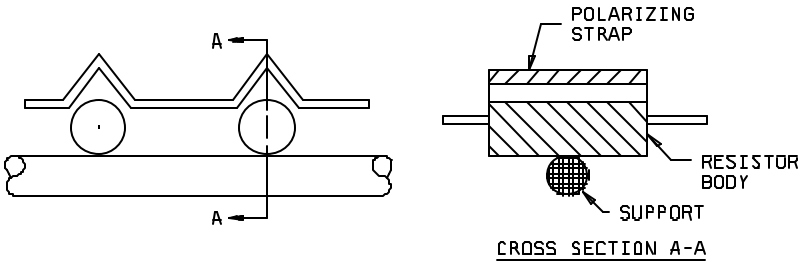

FIGURE 2. Mounting strap for wire lead terminal resistors.

c. Polarization and loading voltage: The resistors shall be divided into two equal groups; one group shall be subjected to polarization and the other group to load.

(1) Polarization: During step 1 to step 6 inclusive, a 100 volt dc potential shall be applied with the positive lead connected to the resistor terminals tied together, and the negative lead connected to the mounting hardware or polarizing straps, as applicable.

(2) Loading voltage: During the first two hours of step 1 and step 4, a dc test potential equivalent to 100 percent rated wattage, but not exceeding the maximum rated voltage shall be applied to the resistors. Where potential to ground is over 250 volts, supplementary insulation shall be provided.

d. Final measurements: Upon completion of step 6 of the final cycle, the resistors shall be conditioned at a temperature of 25°C ±2°C, and at a relative humidity of 90 percent to 95 percent for a period of 1 hour 30 minutes to 3 hours 30 minutes. After conditioning, the resistors shall be removed from the chamber and within 8 hours, the dc resistance and insulation resistance shall be measured as specified in 4.7.8b. Wiping and forced air drying prior to measurement is not allowed. The subsequent 4 hour to 24 hour conditioning period and measurements do not apply.

e. Examinations after test: Resistors shall be examined for evidence of breaking, cracking, spalling, and loosening of terminals and mounting hardware.

4.7.9 Dielectric withstanding voltage (see 3.13). This test shall be performed not less than 10 minutes, nor more than 30 minutes, after the preceding test (This time limit is not applicable to barometric pressure potion of 4.7.9.1). Resistors shall be tested in accordance with method 301 of MIL-STD-202. The following details and exceptions shall apply:

a. Special preparations for wire lead terminal resistor: As specified in 4.7.7.b(2).

b. Initial measurement: Dc resistance shall be measured as specified in 4.7.2.

c. Magnitude of test voltage: 500 volts rms.

d. Nature of potential: An ac supply at commercial line frequency and waveform.

e. Duration of application of test voltage: 1 minute.

f. Rate of application of test voltage: The test voltage shall be raised from zero to 500 volts rms, as uniformly as practicable, at a rate of approximately 100 volts rms per seconds.

g. Points of application of test voltage: Between the resistor terminals connected together and the mounting hardware, or the V-block, as applicable.

h. Measurement after test: DC resistance shall be measured as specified in 4.7.2.

i. Examination after test: Resistors shall be examined for evidence of flashover, mechanical damage, arcing, and insulation breakdown.

4.7.9.1 Barometric pressure (reduced). Resistors shall be tested in accordance with method 105 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of mounting: As specified in 4.7.9a.

b. Initial measurement: DC resistance shall be measured as specified in 4.7.2.

c. Test condition: D.

d. Test voltage during subjection to reduced pressure: 200 volts.

e. Nature of potential: As specified in 4.7.9d.

f. Duration of application of test voltage: 5 seconds.

g. Rate of application of test voltage: 100 volts per second.

h. Points of application of test voltage: As specified in 4.7.9g.

i. Measurement after test: DC resistance shall be measured as specified in 4.7.2.

j. Examination after test: As specified in 4.7.9i.

4.7.10 Terminal strength (see 3.14). Resistors shall be tested in accordance with method 211 of MIL-STD-202. The following details and exceptions shall apply:

a. Test condition: A and D (pull test and twist test, respectively). Applied force (A): 4.5 pounds. Resistor clamped by 1 lead and force applied to other lead.

b. Measurement before and after test: DC resistance shall be measured as specified in 4.7.2.

4.7.11 Life (see 3.15). Resistors shall be tested in accordance with method 108 of MIL-STD-202. The following details and exceptions shall apply:

a. Method of mounting for wire lead terminal resistors: Supported by their terminals. Axial lead resistors at a point 1 inch from the resistor body; printed circuit resistors at a point 3/4 inch from the resistor body. Resistors shall be so arranged that the temperature of any one resistor shall not appreciably influence the temperature of any other resistor. There shall be no undue draft over the resistors.

b. Test temperature and tolerance: 125°C ±5°C.

c. Initial measurements: Measurements may be made inside or outside the chamber.

(1) Inside chamber: When measurements are made inside the chamber, the dc resistance shall be measured at a temperature of 125°C ±5°C after temperature stabilization and within 8 hours of exposure of the resistors to this temperature. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.

(2) Outside chamber: When measurements are to be made outside the chamber, the measurement shall be made after units have been stabilized at room temperature for at least 8 hours. This initial measurement shall be used as the reference temperature for all subsequent measurements under the same conditions.

d. Operating conditions: Rated or maximum dc continuous working voltage shall be applied intermittently, 1-1/2 hours on and 1/2 hour off for 2,000 hours, at the test temperature. Each resistor shall dissipate rated wattage but shall not exceed maximum voltage. Adequate precaution shall be taken to maintain constant voltage on the resistor.

e. Test condition letter: Not applicable, test duration is 2,000 hours.

f. Measurements during test: Measurements may be made inside or outside the chamber. While the resistors are still in the oven, the dc resistance shall be measured as specified in 4.7.2, at the end of the 1/2 hour off periods, after 250 hours +72 hours, -24 hours; 500 hours +72 hours, -24 hours; 1,000 hours +72 hours, -24 hours; 2,000 hours +96 hours, -24 hours have elapsed. Measurement shall be made as near as possible to the specified time but may be adjusted so that measurements need not be made during other than normal work days.

(1) Measurements outside of chamber: When measurements are made outside the chamber, resistors shall be outside of the chamber, for a minimum of 45 minutes and stabilized before measurement.

g. Examination after test: Resistors shall be examined for evidence of mechanical damage.

4.7.12 Resistance temperature characteristic (see 3.16). Resistors shall be tested in accordance with method 304 of MIL-STD-202. The following detail shall apply:

Test temperature - In accordance with table XII.

TABLE XII. Temperature for resistance temperature characteristic test.

Sequence	Temperature (°C ±3°C)
1	1/ 25
2	0
3	15
4	-55
5	-65
6	25
7	50
8	75
9	105
10	145

1/ This temperature shall be considered the reference temperature for each of the succeeding temperatures.

4.7.13 Low temperature storage (see 3.17).

a. Mounting: Resistors shall be mounted by their normal mounting means, in such a manner that there is at least 1 inch of free air space around each resistor, and in such a position with respect to the air stream that the mounting offers substantially no obstruction to the flow of air across and around the resistors.

b. Procedure: DC resistance shall be measured as specified in 4.7.2. Within 1 hour after this measurement, the resistors shall be placed in a cold chamber at -65°C +0°C, -3°C. Twenty-four hours after the resistors have reached this temperature, the temperature of the chamber shall be gradually increased to room temperature within a period of not more than 8 hours. The resistors shall be removed from the chamber and maintained at a temperature of 25°C ±5°C for a period of approximately 24 hours; the dc resistance shall again be measured as specified 4.7.2. Resistors shall then be examined for evidence of mechanical damage.

4.7.14 Low temperature operation (see 3.18). Following the final dc resistance measurement specified in 4.7.13, the resistors, mounted as specified in 4.7.13a, shall again be placed in a cold chamber at room temperature. The temperature shall be gradually decreased to -55°C +0°C, -0°C within a period of not less than 1 hour 30 minutes. After 1 hour of stabilization at this temperature, full rated continuous working voltage as specified in 3.5 shall be applied for 45 minutes. The resistors may be loaded individually or in parallel. Fifteen minutes +5 minutes, -0 minutes after the removal of voltage, the temperature in the chamber shall be gradually increased to room temperature within a period of not more than 8 hours. The resistors shall then be removed from the chamber and maintained at 25°C ±5°C for a period of approximately 24 hours; the dc resistance shall again be measured as specified in 4.7.2. Resistors shall then be examined for evidence of mechanical damage.

4.7.15 High temperature exposure (see 3.19).

a. Mounting: Resistors shall be mounted by their normal mounting means and no soldering shall be used.

b. Procedure: DC resistance shall be measured as specified in 4.7.2 at room ambient temperature. Resistors shall then be exposed to an ambient temperature of 145°C +5°C, -0°C for a period of 24 hours ±4 hours. Not less than 2 hours after the end of the exposure period, the dc resistance shall again be measured as specified in 4.7.2, at room ambient temperature.

4.7.16 Shock, specific pulse (see 3.20). Resistor shall be tested in accordance with method 213 of MIL-STD-202. The following details and exceptions shall apply:

a. Special mounting means: Resistors shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental.

(1) Wire lead terminal resistors: Resistors shall be rigidly mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance of 0.25 inch from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor mounting supports will remain in a static condition with reference to the shock table.

b. Test leads: Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no longer than necessary.

c. Measurement before shock: DC resistance shall be measured as specified in 4.7.2.

d. Test condition: I.

e. Number and direction of applied shocks motion: The resistors shall be subjected to 5 shocks (total of 15 shocks) in each of 3 mutually perpendicular planes. The initial plane shall pass through the resistor axis and terminals and the other two planes shall be mutually perpendicular.

f. Measurement during shock: Each resistor shall be monitored to determine electrical discontinuity by a method which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.

g. Measurement after shock: DC resistance shall be measured as specified in 4.7.2.

h. Examination after test: Resistors shall be examined for evidence of mechanical and electrical damage.

4.7.17 Vibration, high frequency (see 3.21). Resistors shall be tested in accordance with method 204 of MIL-STD-202. The following details and exceptions shall apply:

a. Mounting of specimen: Resistors shall be mounted in relation to the test equipment in such a manner that the stress applied is in the direction which would be considered most detrimental.

(1) Wire lead terminal resistors: Resistors shall be rigidly mounted on appropriate jig fixtures with their bodies restrained from movement and their leads supported at a distance of 0.25 inch from the resistor body. These fixtures shall be constructed in a manner to insure that the points of the resistor mounting supports will remain in a static condition with reference to the vibration table.

b. Test leads: Test leads used during this test shall be no larger than AWG size 22 stranded wire, so that the influence of the test lead on the resistor will be held to a minimum. The test lead length shall be no longer than necessary. A shielded cable, which may be necessary because of the field surrounding the vibration table, shall be clamped to the resistor mounting jig.

c. Measurement before vibration: DC resistance shall be measured as specified in 4.7.2.

d. Test condition: D.

e. Motion: In each of three mutually perpendicular planes; the initial plane shall pass through the resistor axis and terminals, and the other two planes shall be mutually perpendicular.

f. Measurement during vibration: Each resistor shall be monitored to determine electrical discontinuity by a method which shall at least be sensitive enough to monitor or register, automatically, any electrical discontinuity of 0.1 millisecond or greater duration.

g. Measurement after vibration: DC resistance shall be measured as specified in 4.7.2.

h. Examination after test. Resistors shall be examined for evidence of mechanical and electrical damage.

4.7.18 Fungus (see 3.22). Unless certification is provided, resistors shall be tested in accordance with method 508 of MIL-STD-810. Resistors shall be examined for evidence of fungus growth.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department of Defense Agency or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

6.1 Intended use. The resistors covered by this specification are military unique due to the fact that these devices must be able to operate satisfactorily in military systems under the following demanding conditions: 15 g's of high frequency vibration, 50 g's of shock (specified pulse), and 50 g's of acceleration. In addition, these military requirements are verified under a qualification system. Commercial components are not designed to withstand these military environmental conditions.

6.2 Acquisition documents. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Title, number, and date of the applicable association specification, and complete PIN (see 1.2.1 and 3.1).

c. Packaging requirements (see 5.1).

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in QPL whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government, tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC-VQP, Post Office Box 3990, Columbus, Ohio 43216-5000.

6.4 High frequency. Resistors should not be used in circuits where their ac performance is of critical importance in the operation of such circuits, unless supplementary requirements are specified in the contract or order for controlling the ac properties, no type designation should appear on the resistor (see 1.2.1 and 3.19).

6.5 Mounting. It is suggested that wire lead terminal resistors be mounted by restraining their bodies from movement when shock or high frequency vibration forces of the magnitudes, enumerated in this specification, are to be encountered.

6.6 Power rating. The power ratings of these resistors are conservative and are approximately 50 percent of the corresponding commercial ratings.

6.7 Supersession data.

6.7.1 Resistance tolerance. Resistors identified under MIL-R-93C with an initial resistance tolerance of ±0.25 percent (symbol C) may be replaced with resistors from this specification of ±0.1 percent, or ±0.05 percent tolerances.

6.7.2 Resistance temperature characteristic. Resistors of characteristic "E" (although different in numerical value of resistance temperature characteristic are interchangeable with "E" characteristics resistors, under MIL-R-93C. In addition, characteristic "E"," L", and "M" are superseded by characteristic "E" of this specification.

6.7.3 Characteristics and terminal. Resistors identified by temperature characteristic and lead type symbol “C” of this specification, are interchangeable with resistors with characteristic “C” of MIL-R-93C. Temperature characteristic “C” of this specification supersedes characteristics “A” and “C” of MIL-R-93B and covers the temperature range of 125°C to 145°C specified in MIL-R-9444A.

6.7.4 Supersession of styles. The styles in this specification supersede the style of superseded MIL-R-93C, 12 June 1961, “Resistors, Fixed, Wire Wound (Accurate), General Specification for”. and MIL-R-9444A, 20 July 1959, “Resistors, Fixed, Wire Wound, Precision High Temperature, General Specification for”, as listed in table XIII.

TABLE XIII. Supersession of styles.

MIL-R-93D	MIL-R-93C 1/	MIL-R-93B	MIL-R-9444A
RB56	RB56	RB56	
RB55	RB55	RB55	AFRT 10
RB54	RB54	RB54	AFRT 11
RB53	RB53	RB53	AFRT 12
RB52	RB52	RB52	AFRT 13
RB57	RB57		AFRT 14
RB70	RB70		
RB71	RB71		

1/ Resistors in this specification are mutually interchangeable with resistors of the same type designation under MIL-R-93B (see 6.8.3) and MIL-R-93C.

6.8 Subject term (key word) listing.

Axial wire lead terminal
High humidity
Ohm
Resistance
Solderable terminal
Weldable terminal
Windings

6.9 Tin plated finishes. Tin plating is prohibited (see 3.4.2), since it may result in tin whisker growth. Tin whisker growth could adversely affect the operation of electronic equipment systems. For additional information on this matter, refer to ASTM B 545 (Standard Specification for Electrodeposited Coating of Tin).

6.10 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

APPENDIX

PROCEDURE FOR QUALIFICATION INSPECTION

1. SCOPE

1.1 Scope. This appendix details the procedure for submission of sample, with test results, for qualification inspection of resistors covered by this specification. The procedure for extending qualification required sample to other resistors covered by this specification is also outlined herein. This appendix is a mandatory part of the specification. The information contained herein is intended for compliance.

2. APPLICABLE DOCUMENTS (This section is not applicable to this appendix.)

3. SUBMISSION

3.1 Sample.

3.1.1 Single type submission. When qualification is sought for a single resistance value, a sample consisting of 40 coated or enclosed sample units and 2 uncoated or unenclosed sample units in the same resistor style, and lead type, shall be submitted.

3.1.2 Multiple type submission. When qualification is sought for a resistance range, a sample consisting of 34 coated or enclosed sample units and 2 uncoated or unenclosed sample units in the same resistor style, terminal type, and tightest tolerance for which qualification is sought, shall be submitted together with a statement indicating the lowest resistance value manufactured. The number of sample units in group II to group VI, inclusive, of table VII and the applicable resistance value shall be as specified in table XIV. When axial terminal type “C” is submitted (as 34 samples above): Qualification for type “W” in the same style may be granted when an additional 6 samples of type “W” are subjected to group I and group II of table VII. In a similar manner, type “C” may be qualified where “W” is submitted (as 34 sample above), with the submission of 16 additional samples of type “C” resistors to group I, group IA, and Group II of table VII.

4. EXTENT OF QUALIFICATION

4.1 Single type submission. Qualification shall be restricted to the resistance value in the style and resistance tolerance submitted.

APPENDIX

TABLE XIV. Sample units and resistance value for multiple type submission. (For single lead type) 1/

Group number of table VIII	Number of sample units 2/ 3/	Resistance value
Coated or enclosed		
IA	10	Any value
II	6	Highest
III	3	Highest
	3	10,000 ohms or value nearest 10,000 ohms
IV	2	Highest
	2	10,000 ohms (wound with same type wire as highest resistance value)
	2	10 ohms 4/
V	6	10,000 ohms or value nearest 10,000 ohms
Uncoated or unclosed		
VI	2	Highest

1/ Qualification of both leads “C” and “W” is possible by a partial submission of additional samples under 3.1.2.
2/ One additional coated or enclosed sample unit of each resistance value shall be submitted to permit substitution for the defective allowed in group I of table VII.
3/ If the same coatings and materials are not used for all resistance values and tolerances within the same style, an additional submission shall be made for each coating and material. The term “material” in this specification does not apply to the resistance wire element.
4/ 10 ohms or a higher value, if this higher value is the minimum value for which approval is sought.

4.2 Multiple type submission. The resistance range included in the qualification of any one resistor style and terminal shall be between the highest resistance value tested and the lowest resistance value for which qualification is sought, provided the same materials are used within the range qualified. Qualification of resistors by initial resistance tolerance shall qualify resistors of the same style and resistance range in any of the other initial resistance tolerances as listed in table XV provided the same coating, enclosure, and materials are used.

TABLE XV. Extent of qualification by tolerance.

Symbol	Initial resistance tolerance	Will qualify resistance tolerance
A	0.05 percent	A, B, D, F
B	0.1 percent	B, D, F
D	0.5 percent	D, F
F	1.0 percent	F

5. SOLDER DIP (RETINNING) LEADS

5.1 Solder dip (retinning) leads. The manufacturer may solder dip/retin the leads of product supplied to this specification provided the solder dip process has been approved by the qualifying activity.

APPENDIX

5.2 Qualifying activity approval. Approval of the solder dip process will be based on one of the following options:

a. When the original lead finish qualified was hot solder dip lead finish 52 of MIL-STD-1276. (NOTE: The 200 microinch maximum thickness is not applicable). The manufacturer shall use the same solder dip process for retinning as is used in the original manufacture of the product.

b. When the lead originally qualified was not hot solder dip finish 52 of MIL-STD-1276 as prescribed in 5.2a, approval for the process to be used for solder dip shall be based on the following test procedure:

(1) Thirty samples of any resistance value for each style and lead finish are subjected to the manufacturer's solder dip process. Following the solder dip process, the resistors are subjected to the dc resistance test (and other group A electricals). No defects allowed.

(2) Ten of the 30 samples are then subjected to the solderability test. No defects allowed.

(3) The remaining 20 samples are subjected to the resistance to soldering heat test followed by the moisture resistance test. No defects allowed.

5.3 Solder dip retinning options. The manufacture may solder dip/retin as follows:

a. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, 100 percent screening tests shall be repeated on 100 percent of the lot. (NOTE: The manufacturer may solder dip/retin prior to the 100 percent electrical measurements of the group A, subgroup 1 tests). The percentage defective allowable (PDA) for the electrical measurements shall be as for the subgroup 1 tests.

b. As a corrective action, if the lot fails the group A solderability test, the lot may be retinned no more than two times. The lot after retinning shall be 100 percent screened for group A electrical requirements (dc resistance) and parts failing (lot not exceeding PDA for group A, subgroup 1, see 4.6.2.1.1) these screens shall be supplied tot his specification, if electrical failures are detected after the second retinning operation exceeding 1 percent of the lot, the lot shall not be supplied to this specification.

c. After group A inspection has been completed. Following the solder dip/retinning process, the electrical measurements required in group A, subgroup 1, 100 percent screening tests shall be repeated on 100 percent of the lot. The PDA for the electrical measurements shall be as for the subgroup 1 tests. Following these tests, the manufacturer shall submit the lot to the group A solderability test as specified in 4.7.5.

Custodians:
Army - CR
Navy - EC
Air Force - 11
DLA - CC

Preparing activity:
DLA - CC

Review activities:
Army - AV, MI
Navy - AS, CG, MC, OS
Air Force - 19

(Project 5905-1625)

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I RECOMMEND A CHANGE:	1. DOCUMENT NUMBER MIL-R-93E	2. DOCUMENT DATE (YYMMDD) 5 October 2001

3. DOCUMENT TITLE
RESISTORS, FIXED, FILM (HIGH STABILITY), GENERAL SPECIFICATION FOR

4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. REASON FOR RECOMMENDATION

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8. PREPARING ACTIVITY

a. NAME Andrew R. Ernst	b. TELEPHONE (Include Area Code) (1) Commercial 614-692-0552	(2) DSN 850-0552
c. ADDRESS (Include Zip Code) Defense Supply Center Columbus ATTN: DSCC-VAT Columbus, OH 43216-5000	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Standardization Program Office (DLSC-LM) 8725 John J. Kingman Road, Suite 2533 Fort Belvoir, Virginia 22060-6221 Telephone (703) 767-6888 DSN 427-6888	

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